THURSDAY, OCTOBER 13, 1898.

THE NATIONAL PHYSICAL LABORATORY.

THOSE who remember the address by Prof. Lodge at Cardiff, in which he advocated the establishment of a National Physical Laboratory, and the feeling of hopelessness with which the suggestion was received, will be confirmed in the view that the world moves by the fact that a Treasury Commission has now reported in favour of the scheme. Sir Douglas Galton dealt with the question in his presidential address at Ipswich, and, on the following day, read a paper on the Reichsanstalt before Section A. That body then took the matter up in earnest and, even in its so-called decadence, was strong enough to start a movement which was before long supported, with practical unanimity, by all British physicists and chemists. A deputation to Lord Salisbury followed, and a Committee, with Lord Rayleigh as Chairman, was appointed—

> "To consider and report upon the desirability of establishing a National Physical Laboratory for the testing and verification of instruments for physical investigation: for the construction and preservation of standards of measurement: and for the systematic determination of physical constants and numerical data useful for scientific and industrial purposes—and to report whether the work of such an institution, if established, could be associated with any testing or standardising work already performed wholly or partly at the public cost."

The Committee asked various scientific and technical institutions to nominate witnesses, and the evidence thus collected was very interesting and almost entirely in favour of the scheme. The views of those who approached the subject primarily as students of pure science are well known to the readers of NATURE; but it is satisfactory to note that they were warmly supported from the practical point of view by such men as Sir Bernhard Samuelson, Sir William Anderson, Sir Lowthian Bell, Mr. Crompton, Mr. Preece and others directly connected with industry and technology. The number of questions suggested as those on which useful work might be done was indeed almost overwhelming, and the Committee lay stress on the fact that one of the chief functions of the Governing Body would be to select the most important of the various problems with which they might deal. We agree with the opinion of the Committee that a strong Governing Body would arrive at a solution of this difficulty.

The Committee had further to consider the relations between the proposed institution, the Standards Department, and the Electrical Standardising Laboratory of the Board of Trade. They wisely decided that the new institution ought not to be under a Government Department, and as the Board of Trade has statutory powers with respect to the standards, this decision precludes a fusion between the Standards Department and the new Laboratory. It is, however, suggested that the relations between the two should be very close, that the Permanent Secretary of the Board of Trade should be *ex officio* a member of the Governing Body, which "should be consulted by the Standards Office and the Electrical Standardising Department of the Board of Trade upon difficult questions that may arise from time to time or as to proposed modifications or developments."

It is not, however, proposed to found a brand new institution. "In the opinion of the Committee the principles which underlie the proposal for the establishment of a National Physical Laboratory have been tested on a comparatively small scale at the Kew Observatory with the most satisfactory results."

The Committee therefore propose the extension of the Kew Observatory, and as that institution is controlled by the Royal Society it naturally follows that its management when enlarged and developed should remain in the same hands. A considerable change is, however, contemplated in the constitution of the Governing Body. Representatives of industry are to be added, and it is stipulated particularly that these should not necessarily be selected from among the Fellows of the Royal Society.

The plan thus sketched out seems reasonable and practical, and it is to be hoped that the Government will give effect to it.

If it does, and if the Royal Society consent to play the part assigned to it in the Report, the Council will undertake a grave responsibility and enjoy a great opportunity. Much will depend upon the start.

Nothing is said in the report of the Committee as to the funds which would be wanted to carry out the scheme they propose. The form which it ultimately assumes must depend upon whether the Government subvention is large or small. It is, we suppose, improbable that the new institution, if founded, will at first be on the same scale as the Reichsanstalt at Berlin. The question as to whether that institution is not too magnificent has in fact occurred to many of those who have seen it.

No one has ever accused the Kew Observatory of too lordly buildings or too lavish an equipment. As the central thermometric station, it has been hampered by the fact that it has not possessed the apparatus or the means to establish direct comparisons with the gas thermometer. We believe that this difficulty is about to be overcome by the generosity of Sir Andrew Noble who is presenting the necessary installation to the Observatory. But though in this and in other respects it has failed in the past to reach the level of its modern rivals, Kew has been useful both to industry and science. This is proved by its financial success. With a modest endowment of 470*l.* a year and the use of a Government building, the Committee make about 2000*l.* a year in fees, and the average receipts increased in the last five years about 25 per cent. over those in the earlier half of the decade. If a specific example of its operations be needed, it is sufficient to cite the fact that, unsolicited by the trade, Kew established a system of trials for watches, in which the leading makers now eagerly compete, and which they confess has improved the standard of their work.

The more scientific side of the functions of the Observatory is illustrated both by its magnetic work and by the fact that the Committee is now employing a gentleman to compare the platinum thermometer over a wide range with the gas thermometer at the Bureau des Poids et Mesures at Paris. What is wanted is the multiplication of operations

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such as these, together with the systematic determination of selected physical constants. With larger funds such results could be obtained, and there is no reason to fear that with a carefully chosen Committee, a good organisation, and the best Director that can be secured, the National Physical Laboratory would in due time take its place among the great scientific institutions of Europe, and would forge another link in the chain which binds science and industry together.

EXPERIMENTAL PHYSICS.

Lehrbuch der Experimental-Physik. Von Eduard Riecke. Zweiter Band, Magnetismus, Elektrizität, Wärme. (Leipzig: Verlag von Veit und Comp., 1896.)

In Nature for August 20, 1896, we reviewed the first volume of this work, and there stated what seemed to us to be its most notable features. The second volume strikes us as being even better than the first: the author, at any rate, seems to move in the subjects here treated with still more grace and freedom.

The treatment of the subjects is clear, and, so far as we have seen, always accurate, though the methods adopted are not always the newest. Perhaps, it may be argued, they are none the worse for that. However, in one or two places, there are described at some length various pieces of apparatus which hardly deserve a place in a modern book on electricity. An electrician may, for example, know nothing of the "unit jar," and not be a whit the worse. Yet Prof. Riecke gives "Ein vollständiges Bild von der Konstruktion der Massflasche"!

Dielectric action is illustrated by well-chosen and instructive diagrams. The theory described is one precisely analogous to that of magnetic induction and magnetic force, in which the medium is supposed to be made up of polarised molecules, the opposite charges of which act at a distance like other electric charges; while the electric induction is defined as the electrostatic force in a crevasse at right angles to the polarisation, and the electric force as the electrostatic force in a cylindrical hollow along the lines of polarisation. Thus we have in electricity, as in magnetism, the equation

$$\mathfrak{B} = \mathfrak{F} + 4\pi\mathfrak{I}.$$

Here a distinction is drawn between the true and the free distribution on the plate of a condenser, a mode of discussing the external action of the condenser which is supplemented by an all too short account of the Maxwellian view of the subject.

Prof. Riecke gives at p. 23 a simple construction for finding the direction of a magnetic line of force at any point P. Draw to the point a line CP from the centre C of the magnet, and find a point Q such that $CQ = \frac{1}{3}CP$. Draw from Q a perpendicular QR to CP, meeting the magnetic axis in R. RP is the direction of the line of force at P. It ought to be stated in the text that this construction, which is easily derivable from the polar equation $r = c \sin^2\theta$ of the line of force, is only applicable to the case of an infinitely short magnet; that is, it can only be applied for an ordinary bar magnet when the distance CP is very great in comparison with the length of the magnet.

The subject of electromagnetism is fully dealt with so far as the magnetic action of a current element, and the mutual force between two current elements are concerned. The law of Laplace (which was also given by Savary and by Ampère) that the magnetic force produced by a current γ in an element C of a circuit of length ds at a point P at distance r from the element and making an angle θ with CP is $\gamma ds \sin\theta / r^2$, and acts at right angles to the plane of the element and P, is first stated and used for the ordinary applications. Then from that, by the principle of action and reaction, is obtained the electromagnetic force on a current element γds in a field of intensity H, making an angle θ with the element is $\gamma H\, ds \sin\theta$. It is not noticed here, however, that taking the magnetic *action* of an element of current to be as stated in Laplace's formula, the *reaction* must exist in the same line as the action, and hence to get the electromagnetic force on each element the reaction must, after the method of Poinsot, be reduced to a force on the element and a couple.

All these laws of action of elements however are, it should be more emphasised, incapable of absolute demonstration. It is impossible to experiment with elements, and so settle the question, and no confirmation obtained by arriving at the observed actions of complete currents is proved in the least, inasmuch as the addition to the action of an element of any term, which integrated round the circuit gave a zero result would give another law, equally valid so far as the evidence goes. The same point requires mention again later when Ampère's law of the mutual action of two currents is discussed. It seems therefore to be demonstrably certain that in the ordinary theory of circuits it is impossible to arrive at a unique law of the mutual action of elements. Yet time is still wasted on the search for it.

Notwithstanding the narrow limits of the book as compared with many other Lehrbücher, Prof. Riecke has succeeded in compressing an immense amount of valuable matter into his chapters on electricity and magnetism. Of course the pages are large and well filled, and there is far more than would be contained in an English book of the same number of pages, but the author has succeeded wonderfully in contriving to give an account in so much detail of electro-optics, including the electromagnetic theory of light, and of dynamo-electric machinery.

The final chapter, Elektrochemie, Electrolyse, contains a fair discussion of the motion of ions, of electrolytic dissociation, winding up with a sketch of the energy theory of the voltaic cell.

The final part of the second volume deals with heat, and here again, in 130 pages, the author effects quite a marvel of condensation. Temperature, expansion, the air thermometer, all are soundly and clearly treated, and there is an absence of the terrible confusion about scales of the mercury and air thermometers which is so common. For example, we came across again the other day the statement that air is an excellent thermometric substance because its expansion is so *uniform.* The same thing is generally claimed in the same books for mercury, and the authors never seem to think that this uniformity is not absolute, but must be relative to some standard. They do not perceive that the standard they set up is really the expansion of the mercury itself in

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